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Origin of Rigidity in Dry Granular Solids SUMANTRA SARKAR, BULBUL CHAKRABORTY, Brandeis University — In traditional solids, the resistance to shear is associated with broken translational symmetry as exhibited by a nonuniform density pattern. In this talk, we show that the emergence of shear rigidity in granular solids is a collective process, which is controlled solely by boundary forces, the constraints of force and torque balance, and the positivity of the contact forces, and not energetic or entropic considerations. We present a theoretical framework that connects rigidity to broken translational symmetry in a reciprocal space representing contact forces. We apply our theory to experimentally generated shear-jammed states and show that these states are indeed characterized by a persistent, non-uniform density modulation in force space, which emerges at the shear-jamming transition[1]. Crucial to these analyses was an algorithm that was developed to obtain the reciprocal space structures for any real space configuration under mechanical equilibrium. Also, this algorithm help us identify the source of plastic failure which leads to avalanches in these systems. We argue that continuum theories of granular solidification and response should be based on the reciprocal space picture.

[1]Sumantra Sarkar et al, Phys. Rev. Lett. 111, 068301

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